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PALEONTOLOGY.—*New Carboniferous invertebrates—I.*¹ GEORGE
H. GIRTY, U. S. Geological Survey.

This paper contains descriptions of two brachiopods, two pelecypods and one gastropod from Arkansas, and one brachiopod from Kansas.

***Streptorhynchus affine*. n. sp.**

Figures 5-11

Shell small, a width of 25 millimeters being the maximum.

The brachial valve is subquadrate, strongly transverse, somewhat contracted at the hinge, straight or emarginate along the anterior border. The convexity is low with, for the genus, a remarkably strong sinus which is narrow posteriorly but widens rapidly toward the front.

The pedicle valve is subconical and rather strongly elevated. It is gently curved from side to side and nearly straight from apex to points in the margin, but as the growth is more or less distorted, these statements are only of general application. The angle made by the cardinal area with the plane of the shell margins varies considerably; usually it is obtuse but it may be a right angle. The height of the area is of course largely determined by the height of the valve and in most specimens it is rather high. The area is often planate but as the beak is apt to be bent to one side or the other, or even backward (rarely forward), so the area is sometimes more or less curved. It is sharply defined on each side by an angular shoulder which in many specimens is emphasized by a depression or groove down the convex or anterior part of the shell.

The surface is marked by rather stout rounded radii which diverge rapidly so that the interspaces make room for frequent intercalations. The radii are rounded and closely arranged; they are generally rather thick but thicker in some specimens than in others. At points of intercalation they are separated by intervals of about their own width; elsewhere they are wider than the intervals. They appear in most specimens to be subequal, but in some the arrangement is more conspicuously alternating and in a few every fourth or fifth one is much stronger than those between. The radii are crossed by sublammellose concentric, crowded, incremental lirae, and varices of growth

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are rather numerous though not very strong. In some specimens the concentric markings are sharply developed; in others they are obscure though this effect can sometimes be ascribed to abrasion.

The interior of the pedicle valve is devoid of septal plates and the dental plates are reduced to thick but low ridges. The apex of some pedicle valves is more or less filled in by a callosity. The brachial valve has a short, broad, bilobate, cardinal process and rather short, though stout socket plates which are bent so that for much of their length they are parallel to the hinge line.

Horizon and locality: Stanton limestone; cut on the Frisco railroad, $1\frac{1}{4}$ miles southeast of Fredonia, Kansas.

***Streptorhynchus suspectum*, n. sp.**

Figures 12-15

Shell rather large, ovate. A large pedicle valve measures 45 millimeters in width, but most are smaller; some associated brachial valves on the other hand are even larger.

The pedicle valve is high and conical. The outline rounds inward rather strongly at the cardinal angles and the hinge is considerably shorter than the width in front. The growth is very irregular and no two specimens have the same shape. In some the apex is twisted to one side or the other or bent backward over the area (never in the opposite direction) and most have abrupt expansions and contractions, or flare in bell fashion at the margin. The area is high but variable. It makes an obtuse angle with the plane of the valves, though in some shells the angle is much wider than in others. The area is generally flat but may be arched, especially in the upper part. It joins the lateral slopes in sharp angles. The pseudo-deltidium is gently convex and very elongate, the height being several times the width of the base, the ratio varying, however, with the height of the valve.

The brachial valve varies in configuration though it varies much less than the other. In describing this valve I can but note the characters of the dorsal shells that occur at the same locality as the ventrals, for in only one instance have the two valves been found in conjunction. Many of the brachial valves are highly convex, rising to a very prominent umbonal region with a steep descent to the depressed beak which sometimes is almost bent in under the parts above. On the other hand, some specimens, mostly small ones, are rather flat and may even be concave in the umbonal region. Many are also marked with constrictions or undulations due to irregular growth.

The surface is crossed by extremely fine sharp radial lirae. On some specimens the interspaces are wider than the lirae; on others, because of more frequent intercalation, they are of about the same size and on many the lirae multiply rapidly over the marginal parts where they are especially fine and crowded.

The internal structures are not well shown by my specimens and my observations are somewhat contradictory. Where any evidence could be gathered at all it seemed in most instances to show that a median septum was absent in the pedicle valve; dental plates, in any strict sense, are also absent, though the edges of the delthyrium are thickened so as to form distinct dental pillars. On the other hand, in one specimen especially, the median line appeared to be signalized by a low thin ridge which though inconsiderable in height, was yet suggestive of a septum. Less pronounced manifestations of a like development were observed on other specimens, but externally all of the specimens present the same appearance and offer no grounds for discrimi-

nation. A rather common peculiarity, though a feature more perhaps of configuration than of structure, is that many specimens are flattened in the rostral region as if compressed and bear a rather deep, rather narrow indentation; this is received by the internal mold which in turn appears as if the shell there had been thickened into an elongated solid platform of irregular shape.

The associated brachial valves have a low blunt median ridge or septum and long and somewhat curved socket plates.

This species is rather clearly distinct from *S. ruginosum* by reason of its more elevated pedicle valve with its correspondingly narrower delthyrium, and it also has finer and more crowded radiating lirae. Some uncommonly low pedicle valves of this species may not differ appreciably from some uncommonly high pedicle valves of that; so also may the surface striae of that species be in some rare specimens almost as fine and crowded as the surface striae of this, but the generality of specimens differs markedly. In configuration *S. suspectum* is more like the species for which Hall and Clarke introduced the name *S. ulrichi*. They did not, however, describe *S. ulrichi* and by way of illustrating it gave but a single figure representing the interior of a pedicle valve. It was later described and figured by Weller and the data thus made available show that the surface striae of *S. ulrichi* are uncommonly coarse, in marked contrast to the surface striae of *S. suspectum* which are uncommonly fine.

Horizon and locality: Pitkin limestone; Fayetteville quadrangle, $\frac{1}{2}$ mi. north of West Fork, Ark.; Eureka Springs quadrangle, eastern border of sec. 21, T 16 N, R 27 W., Ark.

Tetracamera neogenes, n. sp.

Figures 1-4

Shell rather large, subovate. Width greater than the length, the width in the largest specimens seen being 30 millimeters.

Pedicle valve ovate to pentagonal in shape, widest at about the mid-length. The convexity is high longitudinally but transversely rather low. The sinus is broad, subtending an angle considerably more than one-fourth but rather less than one-half that of the whole valve. The posterior end of the valve is nearly planate, but shortly the median part begins to be depressed, the depression becoming somewhat rapidly deeper and broader, producing thus a broad, flat sinus; the sides meanwhile remain nearly flat or are bent down slightly, near the margin. The shell is rather sharply folded downward at the sides of the rostral portion in almost planate areas which slope outward more or less making with the main part of the valve a distinct angle of more than 90°. In gibbous specimens the anterior part of the sinus is somewhat abruptly bent downward to a direction almost perpendicular to the plane of the lateral margins. The plications are broad, subangular, and moderately strong. They become deep and angular toward the antero-lateral margins, but in the posterior third of the shell they are rather obscure. Normally three occur in the sinus and four on each of the lateral slopes, the final one being the angle that defines the inflected areas on either side of the beak.

The brachial valve is highly convex, not much curved in an antero-lateral direction but strongly arcuate from side to side. In gibbous specimens the shell at the anterior margin is abruptly and strongly deflected to a direction almost perpendicular to the part that preceded it. The fold is broad and

flat, occupying about one-third of the valve, the lateral thirds falling away strongly at the sides. The plications are broad, low and more or less rounded. Near the front of the fold they become strong and angular but in the rostral region they are more or less indistinct. Normally four occur on the fold and three on each side. The fold and sinus are not well defined superficially except near the margin, but the deflection which they produce in the line of junction of the valves is abrupt and strong.

The internal structures have not been ascertained in detail, but in essentials they agree with the genus established by Weller. The pedicle valve is provided with two powerful dental plates which are connected with the sides of the valve in the rostral region by buttress plates, one on each side. The dental plates converge toward the median line but meet the bottom of the valve before they meet each other. Consequently they are not supported on a septum to form a spondylium, unless, as the test is very thick such a structure is present but buried within the shelly mass; this is highly improbable. A slight ridge or septum passes down the median line, however, rising from the bottom of the valve between the dental plates. The brachial valve has a well developed median septum which apparently unites with the hinge plate much as in *Camarotoechia*.

Somewhat paradoxically, *T. neogenes* is in its specific characters much more nearly allied to *T. subtrigona*, the oldest of the *Tetracameras*, than to the species which are nearest in geologic age, though *T. neogenes* is considerably younger than any of them. It is smaller than *T. subtrigona* and has fewer plications differently distributed.

Horizon and locality. Pitkin limestone; Yellville quadrangle, near St. Joe, Arkansas.

Nucula elegantula, n. sp.

Figures 19-21

Shell large, strongly transverse, irregularly ovate to subtriangular in outline. The type specimen is 11 millimeters wide, 8 millimeters high and 6 millimeters thick. The convexity is moderately strong. The upper surface of the valves is gently arched but the dorsal margin is abruptly and strongly inflected both before and behind the beak. Shortly, however, these margins bend outward again, so that grooves are formed that rather sharply define a lunule and an escutcheon. These grooves also sharpen the angle made by the inflected margins with the upper surface. The lines thus formed in the side view, meet at the umbo in an angle slightly less than 90° though the outline of the shell, because the lunule and escutcheon project slightly, is a little greater than 90°. Owing to the conformation just described the beaks are very prominent. They are fairly large and strongly incurved; although owing to the obliquity of the axis of the shell the beaks are directed backward, they do not curve in either direction. The outline of the shell as a whole is comparable to a triangle, in which the ventral side is the longest, the anterior side shorter than the ventral side and the posterior side much shorter than either. The ventral outline is rather regularly and strongly convex. The lines defining the umbo are slightly concave; that on the posterior side meets the ventral margin almost in an angle, the anterior end being less abruptly rounded. The anterior and posterior outlines have a duplex character owing to the lunule and escutcheon which are partly visible in the side view and partly obscured.

The surface is marked by fine, regular, concentric striae.

N. elegantula is more similar to *N. illinoisensis* than to any Mississippian species. Its distinguishing characters are its larger size, more transverse shape, and more distinct lunule and escutcheon.

Horizon and locality: Fayetteville shale; Winslow quadrangle, 2 miles north of Cold Spring, Ark.

Deltopecten bellistriatus, n. sp.

Figures 22, 23

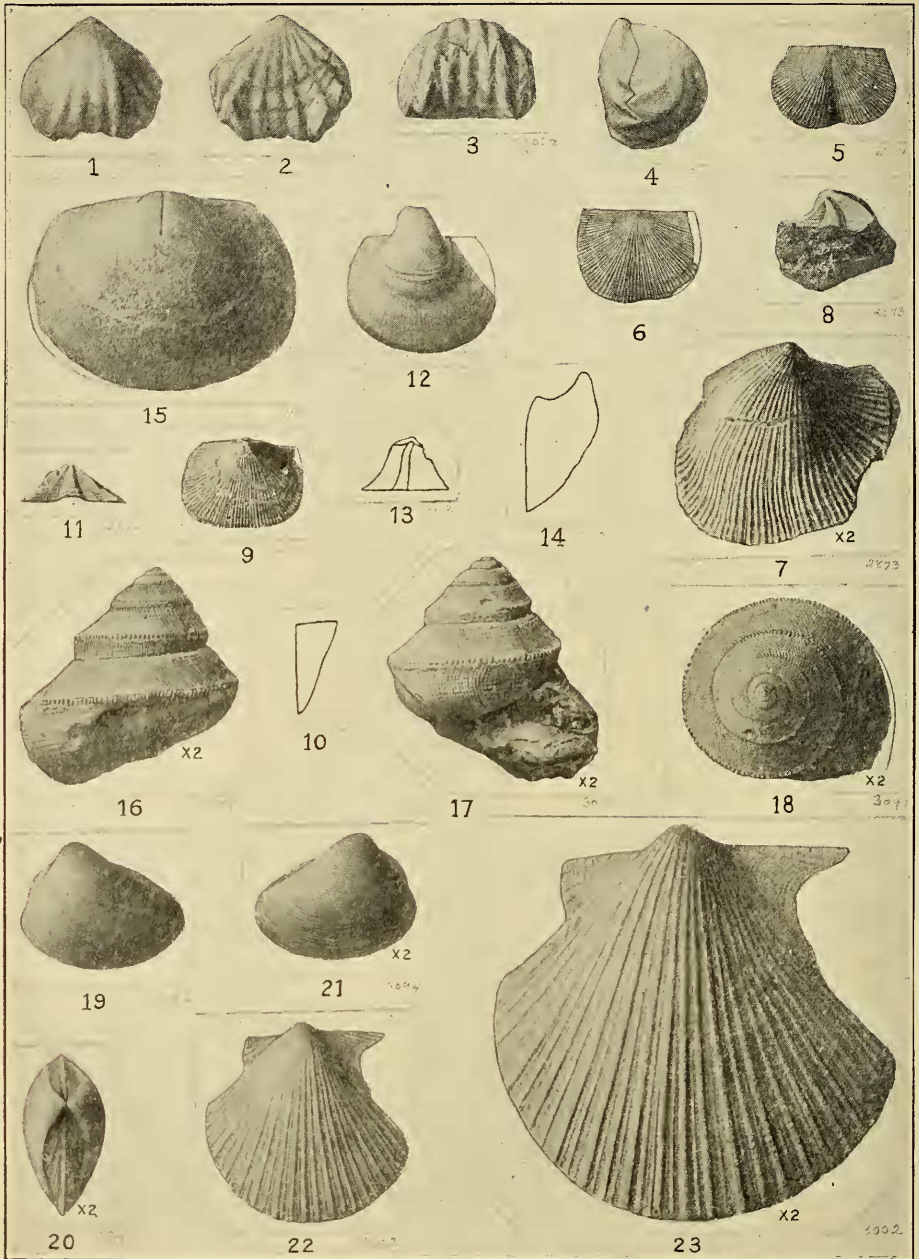
Shell of medium size, rarely 30 millimeters long. Greatest width below the middle, about equal to the length and about one and a half times the hinge line. Axis with a rather strong backward trend.

The left valve is rather convex for the genus, somewhat gibbous in the posterior part with short strong curvature to the beak and long gradual curvature to the ventral margin. The wings are much depressed, the anterior wing more abruptly than the posterior. In fact, the descent to the anterior wing in some specimens undercuts the shell above, forming a deep groove. The posterior wing, though not so abruptly depressed, is as usual, larger than the other. Owing to the configuration just described the body of the shell appears to be sharply defined from the wings and bounded by two nearly straight lines that make between them an umbonal angle of somewhat less than 90°. These lines extend downward beyond the wings, and meet more or less abruptly the broadly curved ventral outline. This curve is not symmetrical for it meets the anterior line at a point above its junction with the posterior line, and it sags appreciably on the posterior side. The projections of the wings above and of the body of the shell below form two broad, deep sinuses in the outline the anterior sinus relatively short and subangular, the posterior sinus relatively broad and rounded.

The surface is marked by costae and by concentric lamellose lines. The primary costae are coarse, and rise boldly from broad shallow interspaces. The interspaces however, are occupied by secondary costae much smaller than the primary ones; their number depends on their position, more being developed over the median part of the shell than over the sides. As many as 4 may occur in one interspace and they vary much in size according to the order of their appearance, those that came in first being almost as large as the primary costae, but those that came in last being very slender. Thus the costae conspicuously alternate in size over the median region but gradually become smaller and more uniform laterally. Those on the wings are especially fine, the transition being more or less abrupt. They are about nine in number and are nearly uniform in size, with only a few intermediate ones. On the body of the shell the intermediate costae are developed by intercalation though some of the large primary costae are double, being incompletely divided into two small ones by a shallow groove introduced on the crest. The concentric lamellose lines are fine and regular, much finer than most of the costae and somewhat more closely arranged. They are distinct on the interspaces and somewhat stronger on the costae, making conspicuous crenulations. Over the wings they are rather crowded though still regular, and these concentric lines as well as the radial ones are distinctly finer on the posterior than on the anterior wing.

The right valve is unknown.

This species is of the general type of *D. monroensis* but it is a larger shell, has a more elongate shape and much coarser sculpture with more conspicuously alternating costae. It resembles *D. batesvillensis* but differs consider-



Figures 1-23 — 1-4, *Tetracamera neogenes* Girty, n. sp.; 5-11, *Streptorhynchus affine* Girty, n. sp.; 12-15, *S. suspectum* Girty, n. sp.; 16-18, *Worthenia tenuilineata* Girty, n. sp.; 19-21, *Nucula elegantula* Girty, n. sp.; 22-23, *Deltopecten bellistriatus* Girty, n. sp.

ably in the character of the sculpture which is coarser, the costae being not only larger but more widely spaced and hence less numerous.

Horizon and locality: Fayetteville shale; Marshall quadrangle, $\frac{1}{2}$ mile southeast of Marshall, Ark.

Worthenia tenuilineata, n. sp.

Figures 16-18

Shell rather large, consisting of 7 volutions. Spire somewhat low (about $\frac{2}{3}$ of the height) and somewhat turreted. Final volution strongly carinate; the carina, which forms the peripheral line and carries the slit band, is situated at about the mid-height. The surface above the carina slopes with strong obliquity from the suture. It is rather broad and is slightly sinuate in outline, a trifle swollen at the suture and gently concave toward the carina. The surface below the carina is directed obliquely downward and inward for a space about equal to the upper surface, then, upward and inward. The surface below the carina is much more highly arched than that above, concave at first for a short distance, then gently convex around to the impressed zone, without any abrupt change of direction. This configuration is confined to the last two volutions more or less, the earlier whorls, 4 or 5 in number, being more regularly rounded. The volutions embrace rather more than half the infra-carinal surface, so that the lower part of the shell is strongly turreted, but the upper part much less so. This difference is due to the rounded shape of the early volutions together with the rapid increase, absolutely if not relatively, in the surface left exposed below the carina by the overlapping whorls.

The surface both above and below the carina is finely cancellated by revolving and transverse lirae, though the upper surface is somewhat more coarsely marked than the lower. The revolving lirae of the upper surface, 13 or 14 in number, are not entirely equal in size or regular in arrangement, but on the

DESCRIPTION OF FIGURES

Tetracamera neogenes, n. sp. (p. 140).

Figs. 1-4. One of the cotypes. Pitkin limestone near St. Joe, Arkansas.

Streptorhynchus affine, n. sp. (p. 140).

Figs. 5-11. Several of the cotypes. Figure 5 represents an uncommonly indented and figure 6 an uncommonly flat brachial valve. Figures 7 and 8 represent a contorted pedicle valve and figures 9-11 represent a more symmetrical one. Stanton limestone near Fredonia, Kansas.

Streptorhynchus suspectum, n. sp. (p. 140).

Figs. 12-15. Two of the cotypes, one of them being a small pedicle valve, the other a much exfoliated brachial valve. Pitkin limestone in the Fayetteville quadrangle (figures 12-14) and in the Eureka Springs quadrangle (figure 15), Arkansas.

Worthenia tenuilineata, n. sp. (p. 140).

Figs. 16-18. The type specimen, $\times 2$. Fayetteville shale, Eureka Springs quadrangle, Arkansas.

Nucula elegantula, n. sp. (p. 140).

Figs. 19-21. The type specimen, $\times 2$. Fayetteville shale, near Cold Spring, Arkansas.

Deltopecten bellistriatus, n. sp. (p. 140).

Figs. 22-23. Two views, one enlarged 2 diameters, of the type specimen, a left valve. Fayetteville shale, near Marshall, Arkansas.

whole they are rather narrower than the interspaces. The transverse markings are more of the nature of lamellae than the revolving ones and are more closely arranged. They trend slightly backward from the suture and take on a more distinct retral curve as they near the carina. The points of intersection with the revolving lirae are marked by fine nodes. For a certain distance below the carina the revolving lirae are rather crowded because of small secondary lirae developed in the interspaces but toward the umbilicus they become somewhat larger and more uniform in size as well as more loosely arranged. The transverse lines are distinctly finer, fainter, and more closely spaced than those above the carina. Their course is doubly sinuate. Swinging strongly forward from the carina they shortly change direction so as to make a broad low arch; this is followed by a broad shallow sinus which in turn is replaced near the axis, by a backward curve.

The carina is formed by the slit band which is inclosed between two sharp edges or lamellae that distinctly define it. The band itself, however, is prominent, projecting beyond the bounding lamellae. It is conspicuously marked by strong, regular lunettes and also by revolving lirae, two in number, that are interrupted by the lunettes and appear only as two rows of small nodes connected by more or less obscure raised lines.

W. tenuilineata appears to be more nearly related to the common Pennsylvanian *W. tabulata* than to any Mississippian species that have been referred under *Worthenia*. In *W. tabulata*, however, the spire is more strongly turreted, the lateral surface is sharply defined by an angle from the lower, and the sculpture, especially that on the lower part of the volutions, is much coarser.

Horizon and locality: Fayetteville shale; Eureka Springs quadrangle, S. E. $\frac{1}{4}$ sec. 15, T 16 N, R 27W., Ark.

PALEONTOLOGY.—*Two new species of "Orthophragmina" from Calita Sal, Peru.*¹ WILLARD BERRY Johns Hopkins University.
(Communicated by JOHN B. REESIDE, JR.)

In 1928 I assigned a new species of "*Orthophragmina*" to a new subgenus *Asterodiscocyliina*.² Since that time other material from the same locality has yielded two more new species of "*Orthophragmina*," which are described in this paper. Many specimens of *Asterodiscocyliina stewarti* W. Berry were also included; several specimens of *Liothyina peruviana* of Olsson, who says that it is found in the Saman Conglomerate near Organo Grande and Quebrada Canoas, Department of Piura, Peru; and "*Orthophragmina*" *peruviana* Cushman, which is found in the Eocene at the horizon of the Saman Conglomerate. Tobler lists "*Orthophragmina*" *asteriscus* Guppy from a locality just south of Calita Sal at Punta Sal.³ I have examined my material

¹ Received March 1, 1929.

² WILLARD BERRY. *Asterodiscocyliina*, a new subgenus of *Orthophragmina*. *Eclogae geol. Helvetiae* 21 (2). 1928.

³ A. TOBLER. *Neue Funde von obereocänen Grossforaminiferen in der nordperuischen Küstenregion*. *Eclogae geol. Helvetiae* 20. 1927.